

## **Spatial distribution of Nd<sup>3+</sup> dopant ions in vitreous silica: A pulsed electron paramagnetic resonance spectroscopic study**

Sen S., Orlinskii S., Rakhmatullin R.

*Kazan Federal University, 420008, Kremlevskaya 18, Kazan, Russia*

---

### **Abstract**

The structural aspects of clustering of Nd<sup>3+</sup> ions in Nd<sub>2</sub>O<sub>3</sub>-doped SiO<sub>2</sub> glasses and the effect of Al<sup>3+</sup> codoping on these clusters have been investigated with pulsed electron paramagnetic resonance (EPR) techniques over a temperature range of 1.5-4 K. The Nd<sub>2</sub>O<sub>3</sub> concentrations in these glasses range between 700 and 2400 ppm by weight. The Nd<sup>3+</sup> echo-detected EPR (EDEPR) spectra of the Al-free glasses show indications of weak exchange coupling between Nd<sup>3+</sup> ions due to clustering. The EDEPR spectra also suggest that the local coordination environment of Nd<sup>3+</sup> ions is affected by codoping with Al. The electronic spin-lattice relaxation rates are found to be not sensitive to the spatial distribution of Nd<sup>3+</sup> ions over the entire temperature range of measurements. On the other hand, the concentration dependence of phase relaxation rates show clear evidence of clustering of Nd<sup>3+</sup> ions in Al-free glasses, even at the lowest Nd<sub>2</sub>O<sub>3</sub> doping levels. These Nd<sup>3+</sup> clusters are found to break up and homogenize with an increase in the average Nd-Nd distance on codoping with Al. Analyses of the hyperfine sublevel correlation spectrum of a Nd and Al codoped glass indicate that the homogenization of Nd<sup>3+</sup> clusters is possibly a consequence of the formation of Nd-O-Al linkages. © 2001 American Institute of Physics.

<http://dx.doi.org/10.1063/1.1338513>

---